

CLAIMS

1. A tire curing system being arranged in at least three horizontally spaced, substantially parallel process lines comprising, a *green tire delivery process line* for use in delivery of a green tire to said tire curing system, a robot tire handling process line along which a robot is selectively moveable and, a manipulator process line along which a manipulator is selectively moveable, said tire curing system having a plurality of molds each having a bottom mold half and a top mold half comprising loading means for loading said green tire into said bottom mold half, mold closing means for placing said top mold half over said bottom mold half, self-locking means for locking said top mold half to said bottom mold half, curing means for curing said green tire, mold opening means for removing said top mold half from said bottom mold half, unloading means for unloading a cured tire from said bottom mold half and take-away means for taking said cured tire away from said curing system, said loading means and said unloading means including a moveable robot and said mold closing means and said mold opening means including a moveable manipulator, wherein the movements of said robot and said manipulator are in a straight line, and,

said tire curing system being arranged with a fourth horizontally spaced, substantially parallel process line including a mold load-unload process line for use in loading green tires into said bottom mold half and for unloading said cured tire from said bottom mold half.

2. The tire curing system of claim 1 further comprising said robot tire handling line being positioned between said green tire delivery process line and said mold load-unload process line, and said manipulator process line being positioned next to said mold load-unload process line.
3. The tire curing system of claim 1 further comprising each of said four process lines having a plurality of stations and each of said four process lines having the same number of said stations.
4. The tire curing system of claim 3 further comprising said bottom mold half being transferable between said manipulator process line and said mold load-unload process line.
5. The tire curing system of claim 4 further comprising said curing means including a center-mechanism that is transferable between said manipulator process line and said mold load-unload process line along with said bottom mold half.
6. The tire curing system of claim 1 further comprising, a take-away conveyor assembly for carrying said cured tire away from said tire curing system, said take-away conveyor assembly being positioned along said robot tire handling line.

7. The tire curing system of claim 6 further comprising said take-away conveyor assembly being positioned below said robot in said robot process line.

8. The tire curing system of claim 1 further comprising said bottom mold half including a plurality of segments, said top mold half and said bottom mold half forming a segmented mold, said manipulator including an actuator mechanism for locking and unlocking said top mold half and said bottom mold half, and said actuator mechanism comprising,

an actuator cylinder for raising and lowering said actuator mechanism,

an actuator ring selectively sliding said segments inwardly and outwardly,

10 a first actuator motor for selectively rotating said actuator ring,

a first actuator rod operatively connecting said first actuator motor to said actuator ring,

and,

an actuator frame for supporting said actuator ring, said first actuator motor and said first actuator rod.

15 9. The tire curing system of claim 8 further comprising each of said segments having a cam-follower actuator for use in sliding each of said segments, and said actuator ring comprising,

first and second actuator wedges for selectively engaging each of said cam-follower actuators.

20 10. The tire curing system of claim 8 further comprising the amount of rotation of said actuator ring required to open and close the segmented mold being within the range of 5° to 15°.

11. The tire curing system of claim 8 further comprising said manipulator comprising,

an attachment frame for selective attachment to the top mold half, said attachment frame

25 having a plurality of hooks,

a plurality of hoists for selectively raising and lowering said attachment frame, said plurality of hoists being operatively attached to a top member of said manipulator,

hoist cables operatively connecting said plurality of hoists to said plurality of hooks, and,

30 a plurality of cylinders have piston rods, selectively extending from said top member of said manipulator to said attachment frame for stabilizing said attachment frame as it is moved with said manipulator.

12. A method for curing a first green tire using a curing system having four horizontally spaced substantially parallel process lines with a plurality of stations along each process line, each of said four process lines having the same number of stations, said four process lines

including a manipulator process line, a mold load-unload process line, a robot tire handling line, and a green tire delivery process line, wherein the method comprises the steps of:

depositing the first green tire at a first station on the green tire delivery process line;

5 moving a robot along said robot tire handling line to a first station on the robot tire handling line;

moving a manipulator along the manipulator process line to a first station on the manipulator process line;

10 lifting a first top mold half from a first bottom mold half positioned at said first station on the manipulator process line with said manipulator;

moving said first bottom mold half to a first station on the mold load-unload process line;

placing said first green tire on said first bottom mold half with said robot;

moving said robot along said robot tire handling line as required;

15 moving said first bottom mold half to said first station on said manipulator process line;

placing said first top mold half onto said first bottom mold half with said manipulator;

moving said manipulator along said manipulator process line as required;

vulcanizing the first green tire into a first cured tire;

20 moving said manipulator along said manipulator process line to said first station on said manipulator process line;

lifting said first top mold half from said first bottom mold half with said manipulator;

moving said robot along said robot tire handling line to said first station on said robot tire handling line;

25 moving said first bottom mold half to said first station of said mold load-unload process line;

removing said first cured tire from said first bottom mold half with said robot;

moving said first bottom mold half to said first station on said manipulator process line;

and,

placing said first cured tire on a take-away conveyer with said robot.

30 13. The method of claim 12 further comprising, before the step of depositing said first green tire at a first station on the green tire delivery process line,

carrying said green tire to said curing system on a monorail that runs alongside said green tire delivery process line.

14. The method of claim 12 further comprising, before the step of moving said first bottom mold half to said first station on said manipulator process line,
beginning to shape said first green tire with a bladder.
- 5 15. The method of claim 12 further comprising, after the step of placing said first top mold half over said first bottom mold half with said manipulator,
locking said first top mold half to said first bottom mold half with said manipulator.
16. The method of claim 12 further comprising after the step of moving said robot along said robot tire handling line,
10 depositing a second green tire at a second station on said green tire delivery process line;
and,
moving said robot along said robot tire handling line to a second station on said robot tire handling line.
17. The method of claim 16 further comprising after the step of moving said manipulator
15 along said manipulator process line to said first station,
moving said manipulator along said manipulator process line to a second station on said manipulator process line;
lifting a second top mold half from a second bottom mold half positioned at said second station on said manipulator process line with said manipulator;
- 20 moving said second bottom mold half to a second station on said mold load-unload process line;
placing a second green tire into said second bottom mold half with said robot;
moving said second bottom mold half to said second station on said manipulator process line;
- 25 placing said second top mold half over said second bottom mold half with said manipulator;
moving said manipulator along said manipulator process line as required; and,
vulcanizing said second green tire into a second cured tire.
18. The method of claim 17 further comprising, after the step of placing said first cured tire
30 onto a take-away conveyer with said robot,
moving said manipulator along said manipulator process line to said second station on said manipulator process line;
lifting said second top mold half from said second bottom mold half with said manipulator;

moving said robot along said robot tire handling line to said second station;
 moving said second bottom mold half to said second station on said mold load-unload
 process line;

- 5 removing a second cured tire from said second bottom mold half with said robot;
 moving said second bottom mold half to said second station on the manipulator process
 line; and,
 placing the second cured tire onto a take-away conveyer with said robot.

19. A segmented tire mold comprising a top mold half and a bottom mold half including a
 10 plurality of segments and self-locking means for selectively locking said top mold half to said
 bottom mold half, said self-locking means comprising,

- a lock frame,
 a first lock motor supported by said lock frame,
 a first lock rod rotatably connected to said first lock motor, and
 15 including a quick connect coupling,
 a lock ring for use in preventing said segments from sliding outwardly, said lock ring
 being selectively connected to said first lock rod at said quick connect coupling, and,
 a lock cylinder operatively connected to said lock frame for use in selectively raising and
 lowering said lock frame, said first lock motor, said first lock rod and said lock ring, said lock
 20 cylinder thereby selectively placing said lock ring around said segmented tire mold.

20. The segmented tire mold of claim 19 further comprising,
 second and third lock motors supported by said lock frame,
 second and third lock rods rotatably connected to said second and third lock motors
 respectively, said second and third lock rods each including a quick connect coupling,

- 25 wherein said lock ring is selectively connected to said second and third lock rods at said
 quick connect couplings, and,

wherein said lock cylinder selectively raises and lowers said second and third lock
 motors and said second and third lock rods.

21. A method for locking a mold with a bottom mold half having a plurality of segments and
 30 a top mold half comprising the steps of,

providing a locking mechanism that includes a lock frame, a first lock motor supported
 by said lock frame, a first lock rod rotatably connected to said first lock motor and including
 a quick connect coupling, a lock ring selectively connectable to said first lock rod at said
 quick connect coupling, and a lock cylinder operatively connected to said lock frame,

lowering said lock frame until said lock ring is positioned around said plurality of segments,

- driving said first lock motor thereby rotating said first lock rod and disconnecting said
5 first lock rod from said lock ring at said quick connect coupling, and,
lifting said locking mechanism away from the mold,
coupling, and,
lifting said locking mechanism away from the mold.

22. The method of claim 21 further comprising the steps of,

- 10 lowering said lock frame until said first lock rod engages said lock ring at said quick
connect coupling,
driving said first lock motor thereby rotating said first lock rod and connecting said first
lock rod to said lock ring at said quick connect coupling, and,
lifting said lock ring away from said mold.

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